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14. ABSTRACT

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MEMORANDUM FOR PRS (In-House Publication)

FROM: PROI (STINFO)

27 June 2002

SUBJECT: Authorization for Release of Technical Information, Control Number: **AFRL-PR-ED-VG-2002-167**
C.T. Liu (PRSM) et al., "Estimating the Equivalent Initial Crack Size in a Particulate Composite Material under a Multi-Axial Loading Condition" (viewgraphs)

Int'l Conf. on Computational Engineering & Science
(Reno, NV, 31 July - 02 August 2002) (Deadline: 30 July 2002)

(Statement A)

1. This request has been reviewed by the Foreign Disclosure Office for: a.) appropriateness of distribution statement, b.) military/national critical technology, c.) export controls or distribution restrictions, d.) appropriateness for release to a foreign nation, and e.) technical sensitivity and/or economic sensitivity.

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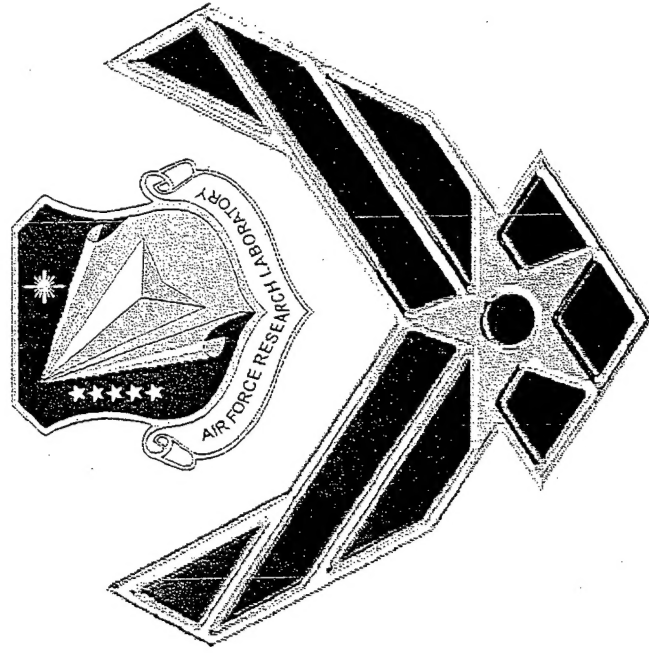
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APPROVED/APPROVED AS AMENDED/DISAPPROVED

PHILIP A. KESSEL Date
Technical Advisor
Space and Missile Propulsion Division

Estimating the Equivalent Initial Crack Size in a Particulate Composite Material under a Multi- Axial Loading Condition



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Objectives

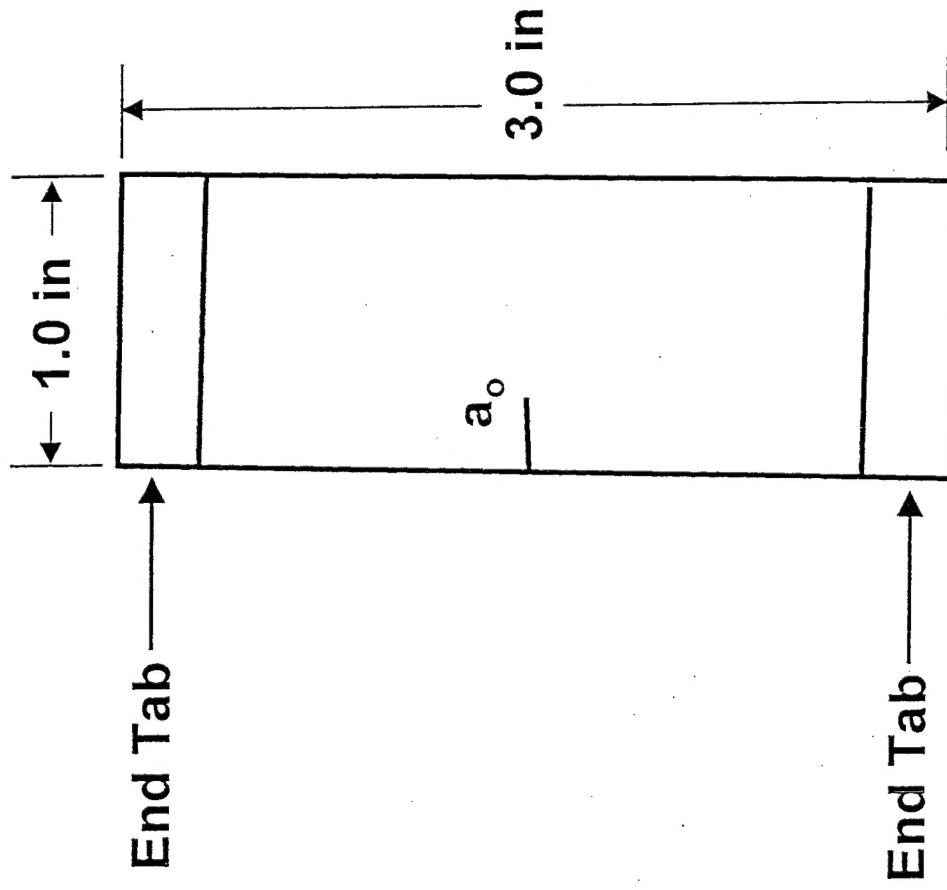


- Investigate the Effect of Confined Pressure on the Equivalent Initial Crack Size in a Particulate Composite Material under a Constant Strain Rate of 18.18 in/in/min.
 - Confined Pressures: Ambient and 1000 psi
- Determine the Statistical Distribution Function of the Equivalent Initial Crack Size.
 - Normal Distribution
 - Two-Parameter Lognormal Distribution
 - Two-Parameter Weibull Distribution
 - Second Asymptotic Distribution of the Maximum Value



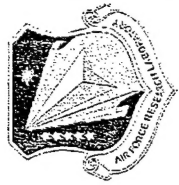
Liu 31May02.ppt

Specimen Geometry





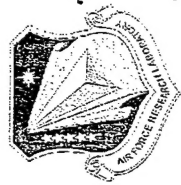
Summary of Crack Lengths (Ambient Pressure)



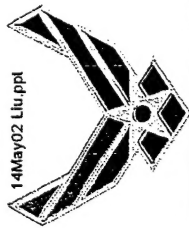
Specimen	a_c	$t_c(\text{sec})$	a^*	$t^*(\text{sec})$	a_0
Specimen 2	0.15425	1.52410	0.14396	0.92817	0.14258
Specimen 3	0.15543	1.56840	0.14530	0.97216	0.14386
Specimen 4	0.15993	1.62110	0.15018	1.04930	0.14888
Specimen 5	0.15268	1.47570	0.14237	0.88766	0.14114
Specimen 6	0.15476	1.45990	0.14506	0.89909	0.14379
Specimen 7	0.15505	1.46360	0.14471	0.87206	0.14348
Specimen 8	0.16073	1.50860	0.15029	0.89749	0.14883
Specimen 9	0.16006	1.49300	0.14973	0.88745	0.14826
Specimen 10	0.15765	1.50720	0.14717	0.89387	0.14575
Specimen 11	0.15902	1.52830	0.14858	0.91423	0.14711
Specimen 12	0.16086	1.49390	0.15115	0.92008	0.14976
Specimen 13	0.15963	1.47920	0.14965	0.89482	0.14819



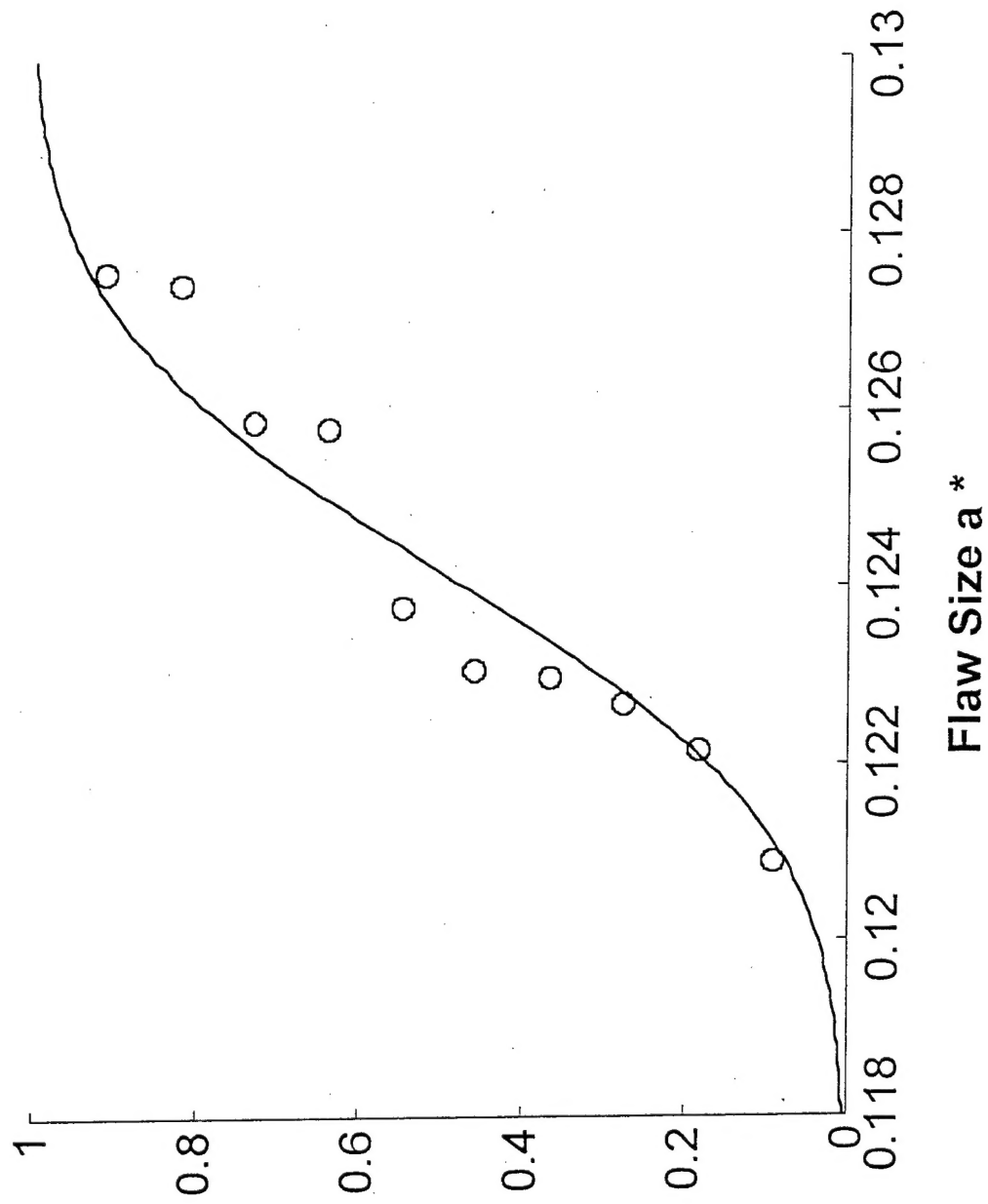
Summary of Crack Lengths (1000 psi Pressure)

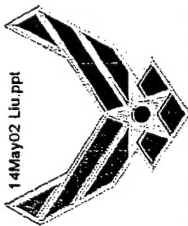


Specimen	a_c	$t_c(\text{sec})$	a^*	$t^*(\text{sec})$	a_0
Specimen 1	0.13691	1.39630	0.12298	0.77889	0.12192
Specimen 2	0.13782	1.42730	0.12268	0.76981	0.12158
Specimen 3	0.14140	1.52430	0.12744	0.90516	0.12641
Specimen 4	0.14225	1.45830	0.12760	0.81887	0.12651
Specimen 5	0.13629	1.43770	0.12089	0.76950	0.11979
Specimen 6	0.13644	1.40720	0.12216	0.77942	0.12109
Specimen 7	0.13812	1.38830	0.12379	0.76062	0.12271
Specimen 8	0.13994	1.37600	0.12581	0.75726	0.12472
Specimen 9	0.14072	1.43480	0.12589	0.79079	0.12480
Specimen 10	0.13765	1.44890	0.12307	0.80817	0.12199

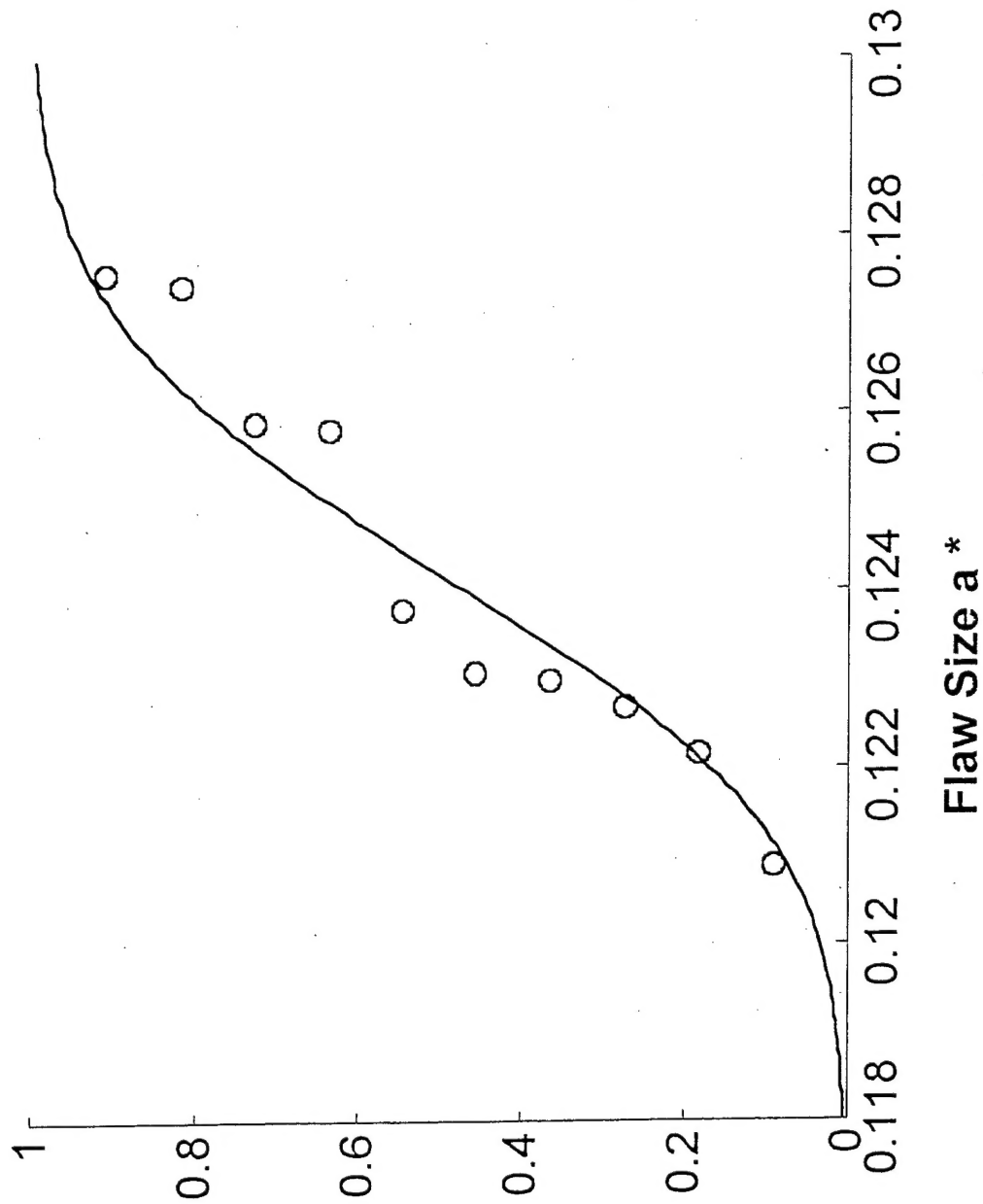
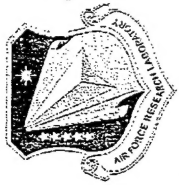


Normal Distribution Plot for a *



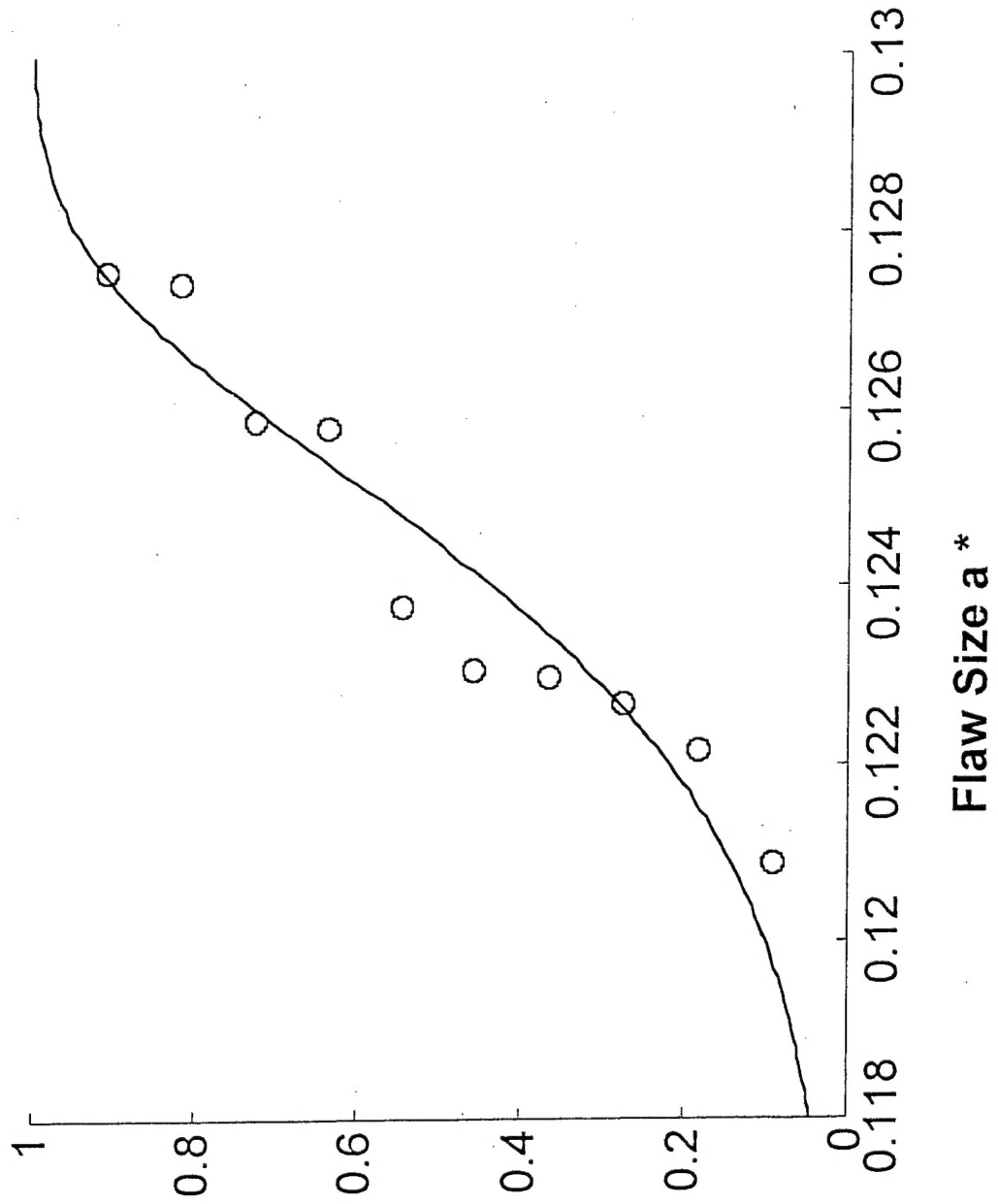


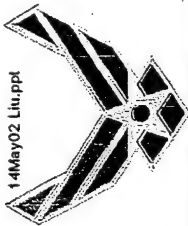
Lognormal Distribution Plot for a *



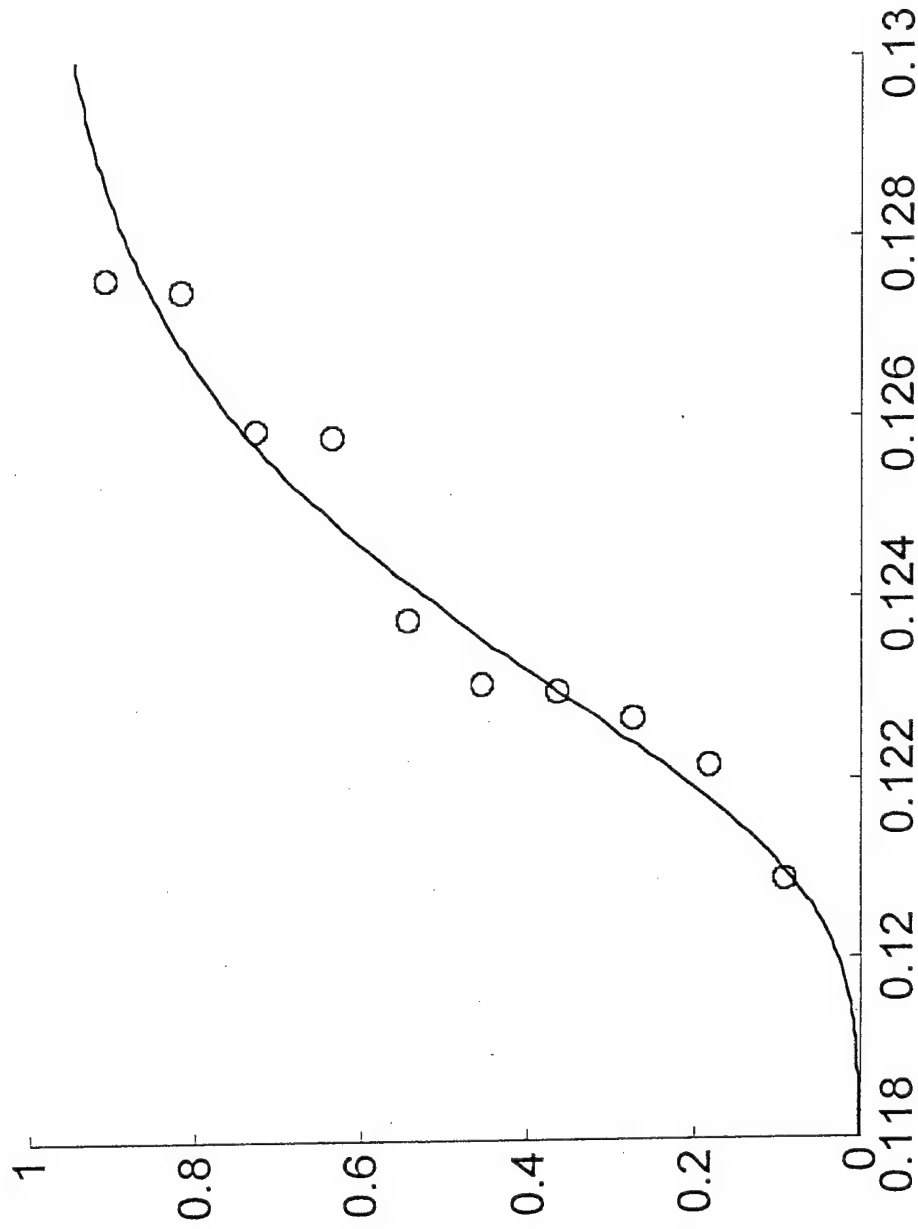
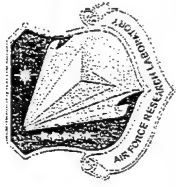


Weibull Distribution Plot for a *



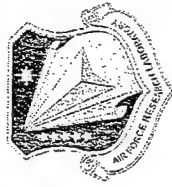


Second Asymptotic Distribution of Maximum Value Plot for a^*



Crack Size a^*

Distribution Parameters for Normal, Two-Parameter Lognormal, Two-Parameter Weibull, and Second Asymptotic Distribution of Maximum Value (Ambient Pressure)



	a_c	a^*	a_0
μ	0.15750	0.14735	0.14597
σ	0.00290	0.00296	0.00290
μ^*	-1.84847	-1.91517	-1.92456
σ^*	0.01842	0.02008	0.01989
α	53.6601	49.5994	50.0668
β	0.1590	0.1488	0.1474
κ	51.3708	47.7906	48.4144
ν	0.1559	0.1458	0.1444



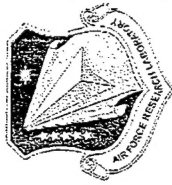
Distribution Parameters for Normal, Two-Parameter Lognormal, Two-Parameter Weibull, and Second Asymptotic Distribution of Maximum Value (1000 psi Pressure)



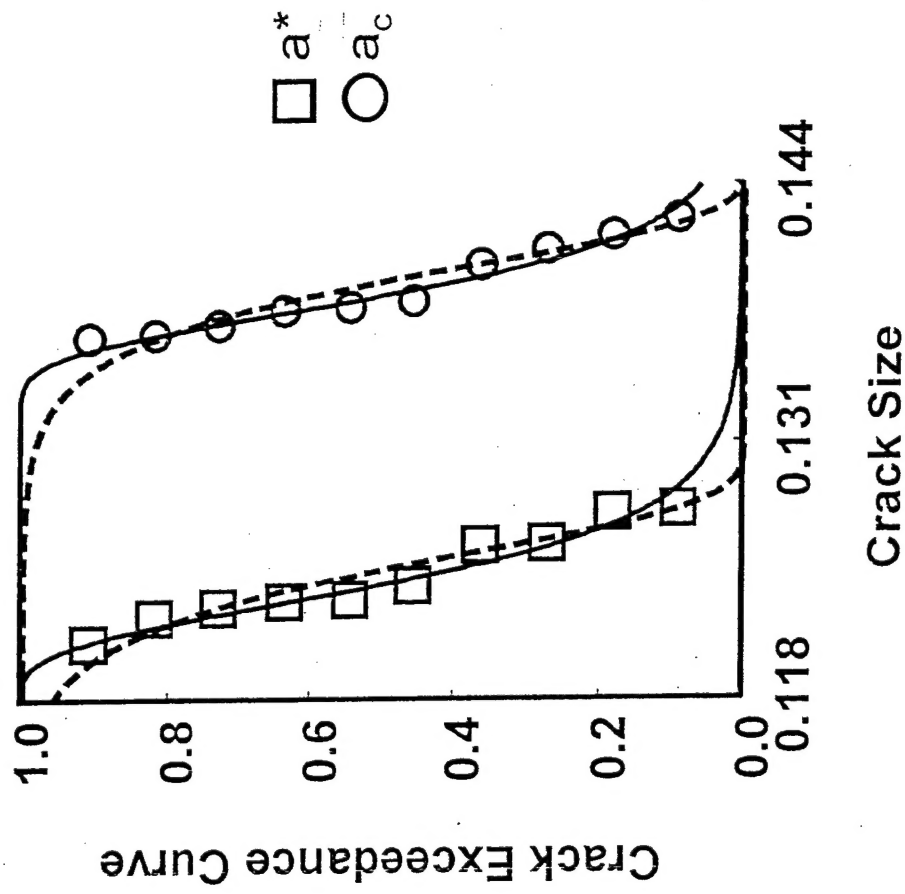
	a_c	a^*	a_0
μ	0.13875	0.12423	0.12315
σ	0.00216	0.00231	0.00231
μ^*	-1.97517	-2.08578	-2.09451
σ^*	0.01553	0.01856	0.01878
α	60.3527	51.4485	50.8397
β	0.1399	0.1254	0.1243
κ	63.2361	52.4640	51.8168
v	0.1377	0.1230	0.1220



Crack Exceedance Curves for Equivalent Initial Crack Size and Critical Crack Size (Strain Rate 18.18 min⁻¹; 1000 psi Pressure);



Solid Curves for Second Asymptotic Distribution of Maximum Value and Dashed Curves for Weibull Distribution

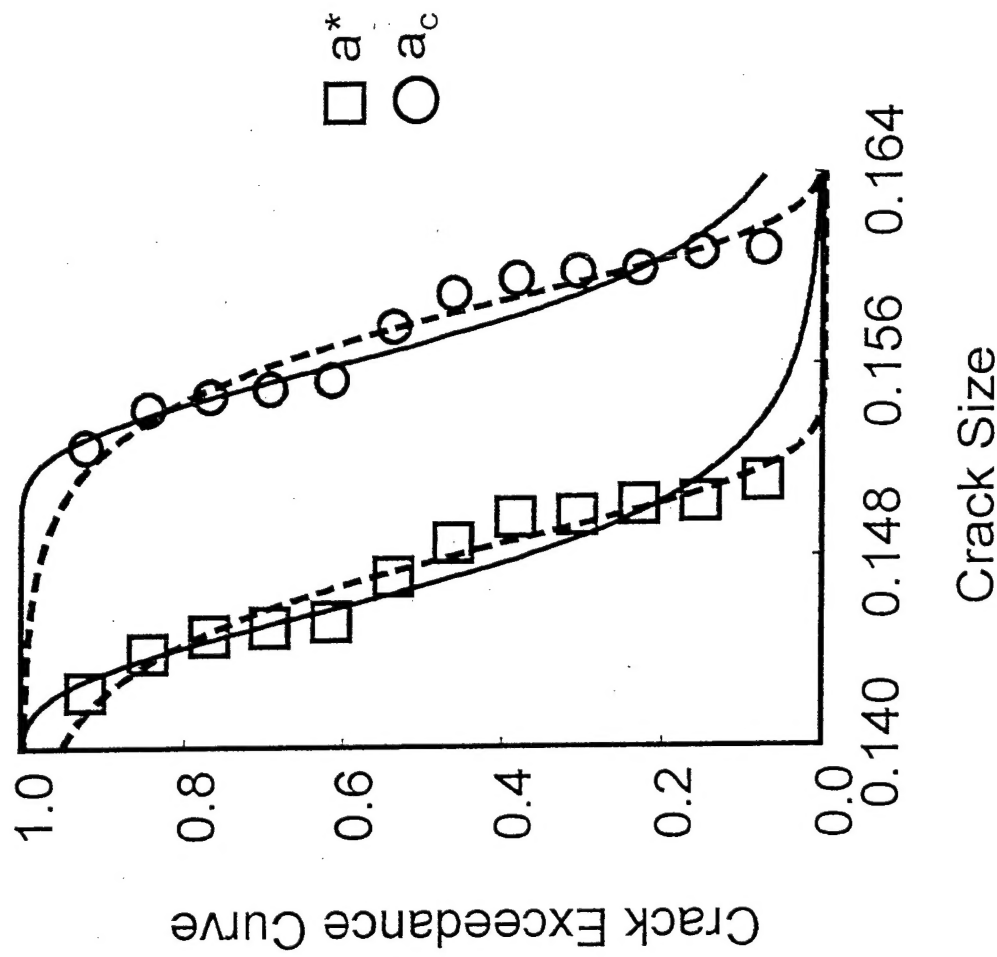




Crack Exceedance Curves for Equivalent Initial Crack Size and Critical Crack Size (Strain Rate 18.182 min⁻¹; Ambient Pressure)



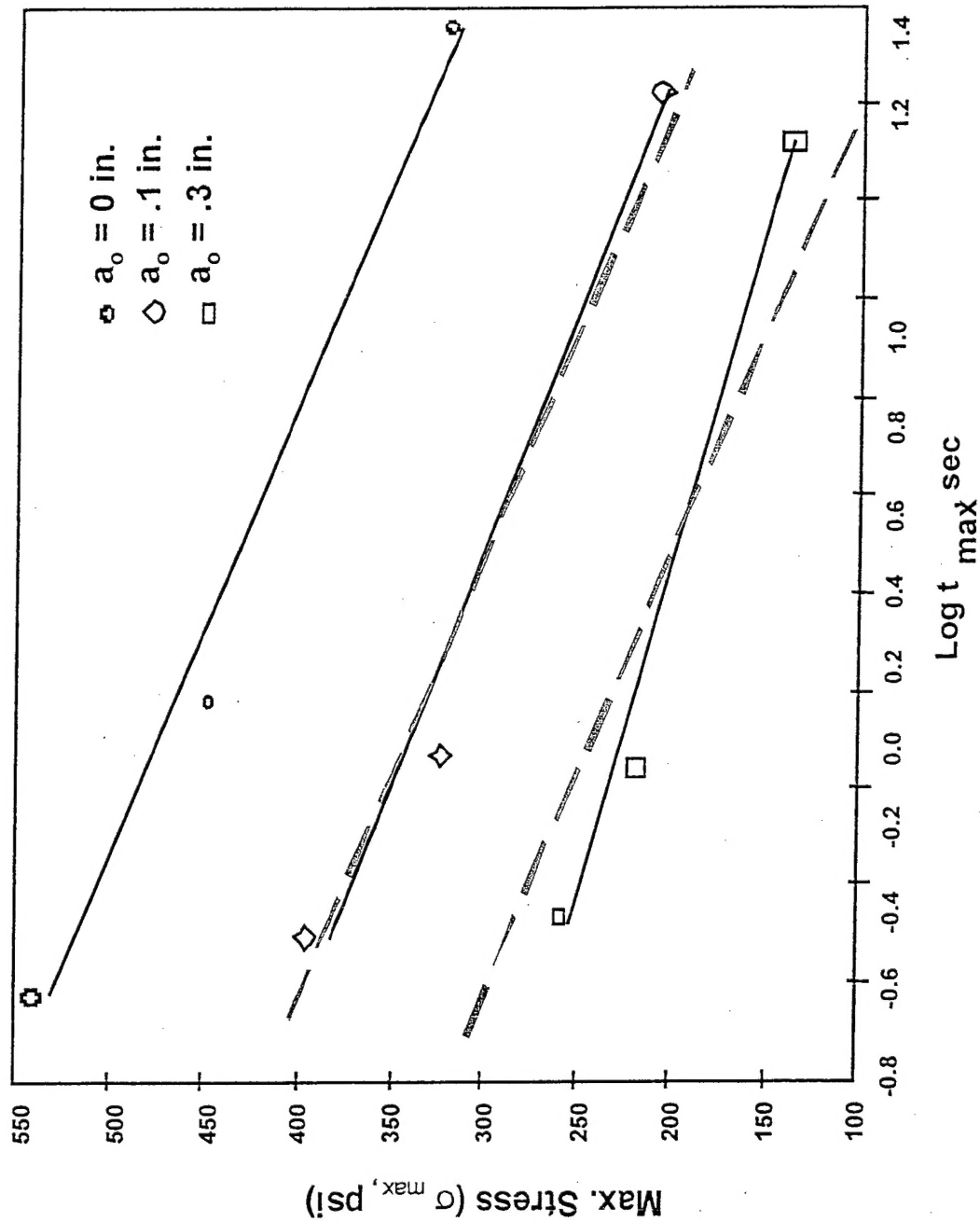
Solid Curves for Second Asymptotic Distribution of Maximum Value and Dashed Curves for Weibull Distribution





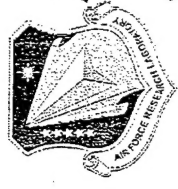
14May02 Liu.ppt

Maximum Stress Versus Maximum Time





Conclusions



1. For the material investigated, confined pressure has no significant effect on the equivalent initial crack size.
2. The predicted equivalent initial crack size compares well with experimental value.
3. The predicted equivalent initial crack size follows the second asymptotic distribution of maximum value.